

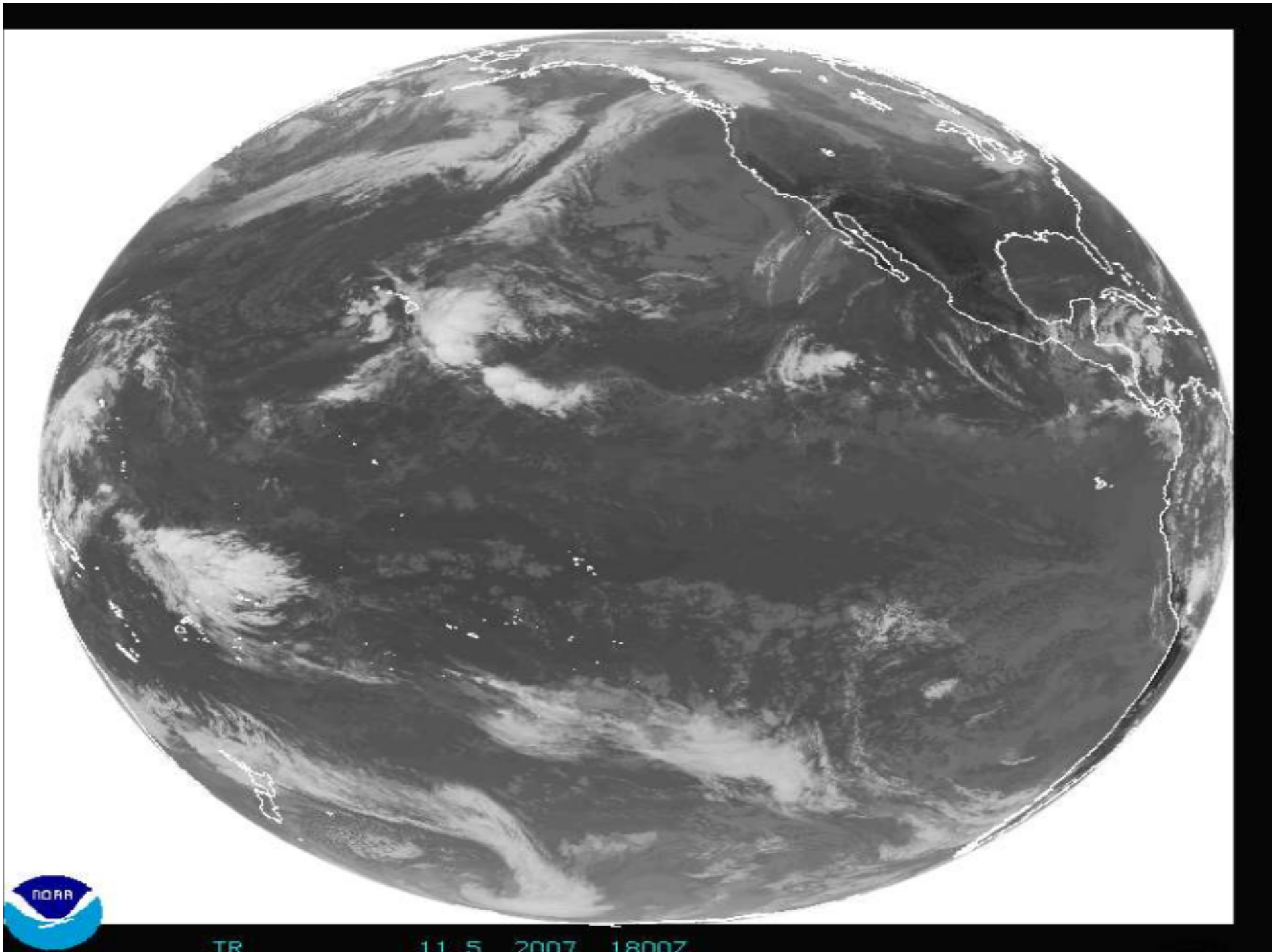


USING MJO FOR WEATHER FORECASTING DURING A LA NINA YEAR

*By Mindy Brugman
Pacific Storm Prediction Centre
Meteorological Survey of Canada
Environment Canada
Vancouver BC*

OUTLINE

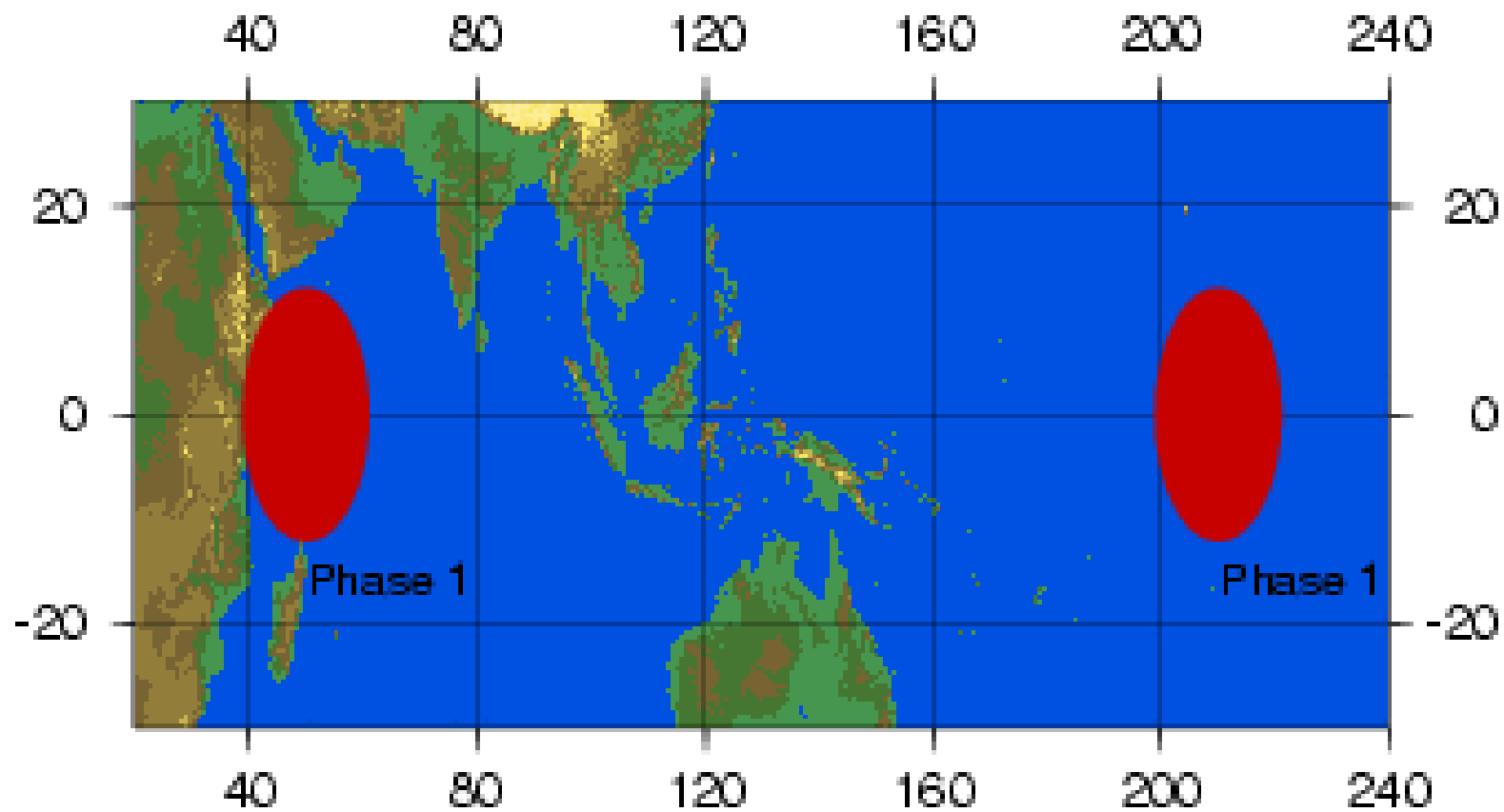
- **MJO** – Madden Julian Oscillation –
 - What is it? Why do we care?
- **La Nina** – Cool Phase of ENSO
 - What does this have to do with MJO?
- How can these assist weather forecasters and evaluation of model performance?
- Application of MJO Wheeler diagram for tracking MJO oscillations and related Blocking
- Relationship between ENSO, MJO and AO



IR

11 5 2007 1800Z

MJO PHASE 1 TO 8

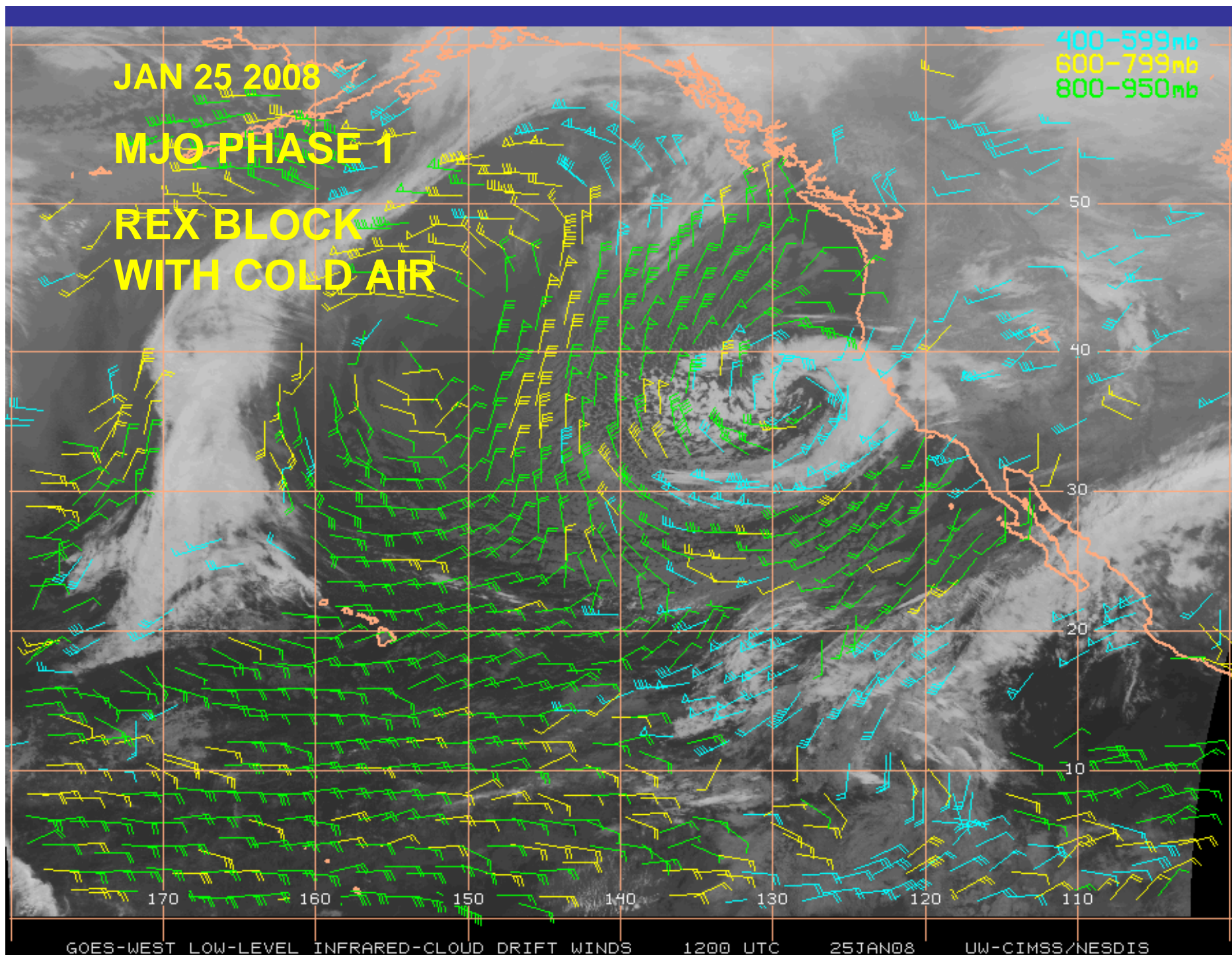


JAN 25 2008

MJO PHASE 1

**REX BLOCK
WITH COLD AIR**

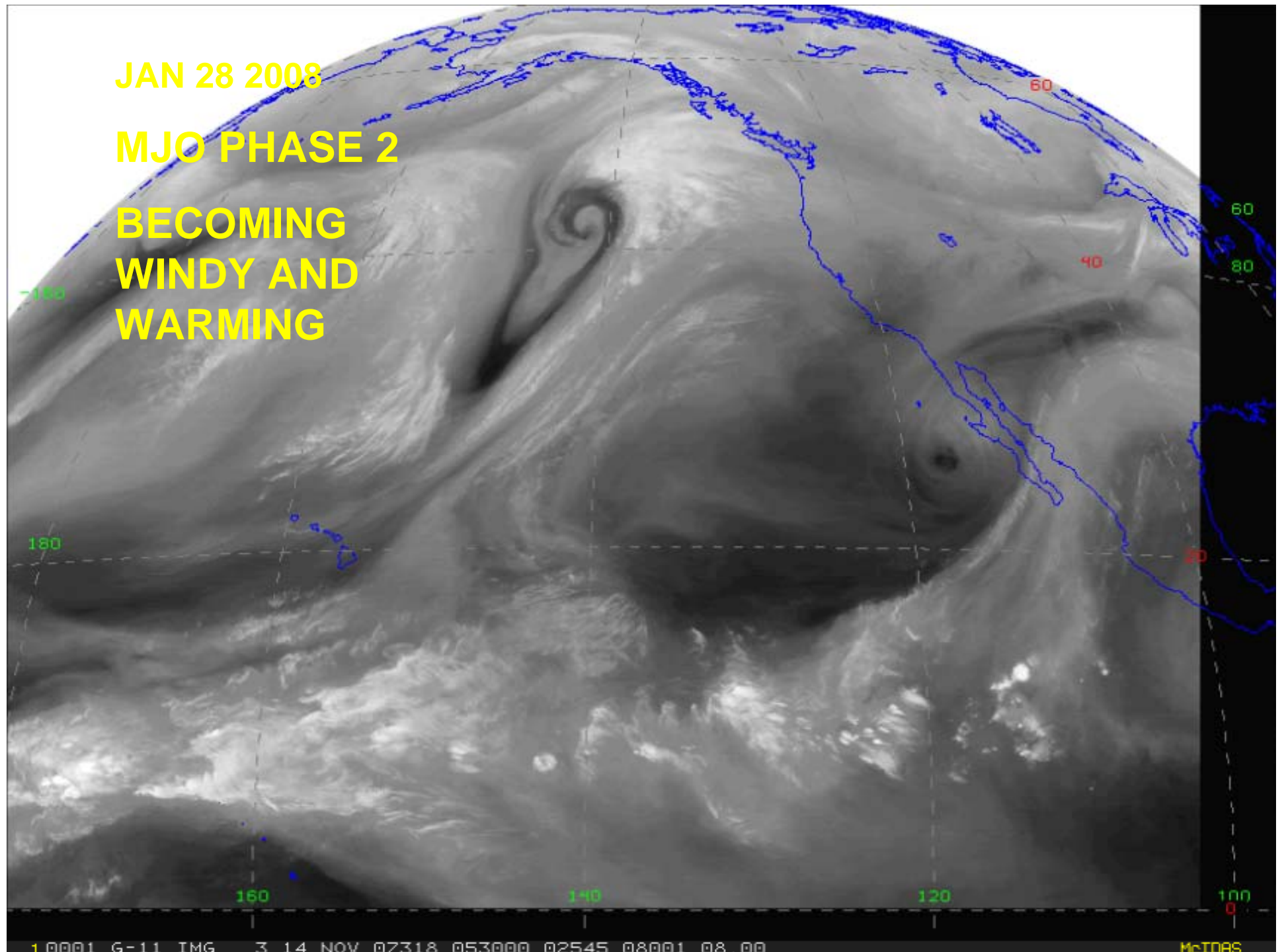
400-599mb
600-799mb
800-950mb



JAN 28 2008

MJO PHASE 2

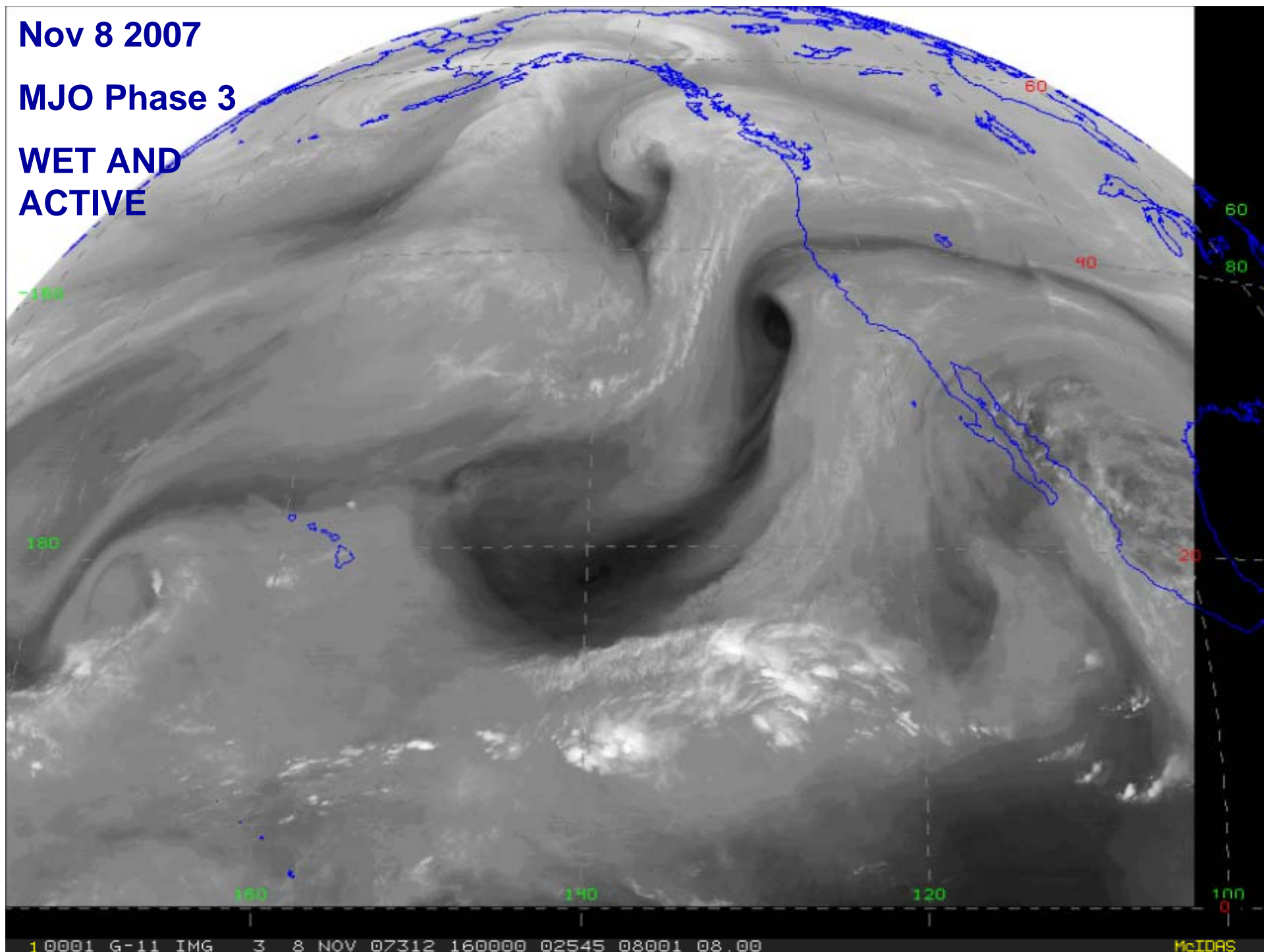
BECOMING
WINDY AND
WARMING



Nov 8 2007

MJO Phase 3

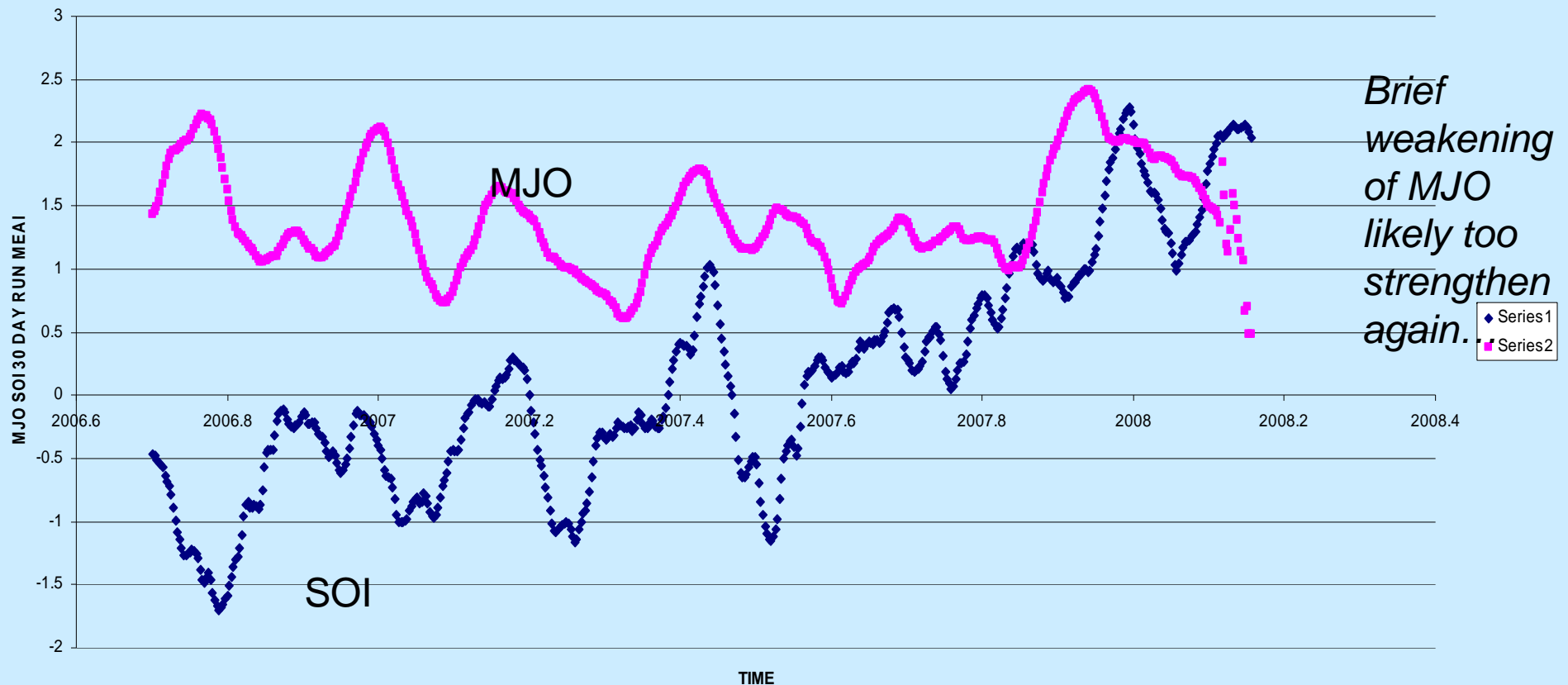
**WET AND
ACTIVE**



ARE SOI AND MJO RELATED?

Clearly interacting but like linked yet independent oscillators or they do the Atmospheric Tango like beginner Salsa Dancers

MJO SOI 30DRM TIME SERIES 2006 TO 08



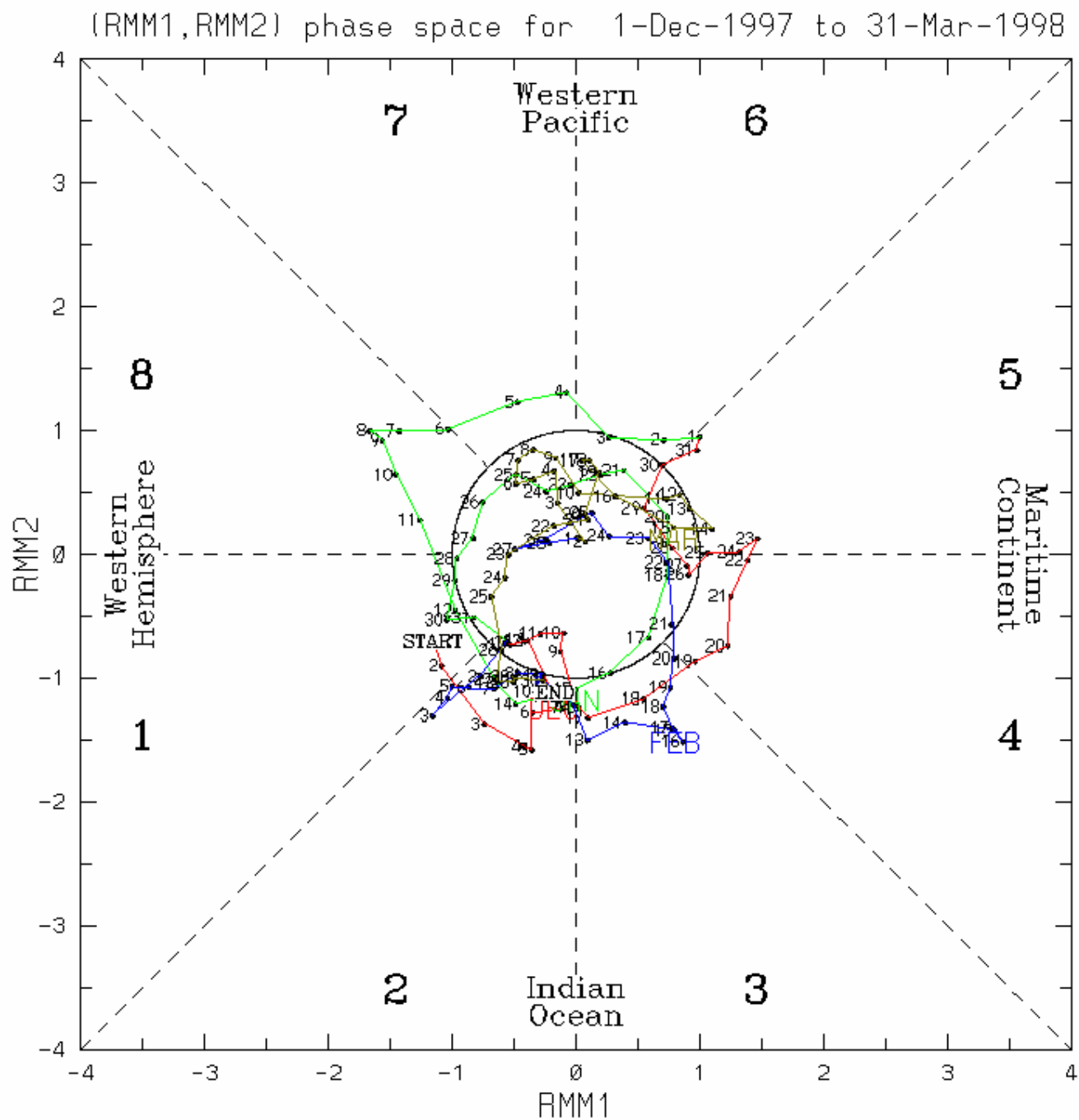
2006 FALL

2007 WINTER

2008 WINTER

MONTHLY RUNNING MEAN

MJO peaks as SOI rapidly changes or is strong Positive (i.e. La Nina)

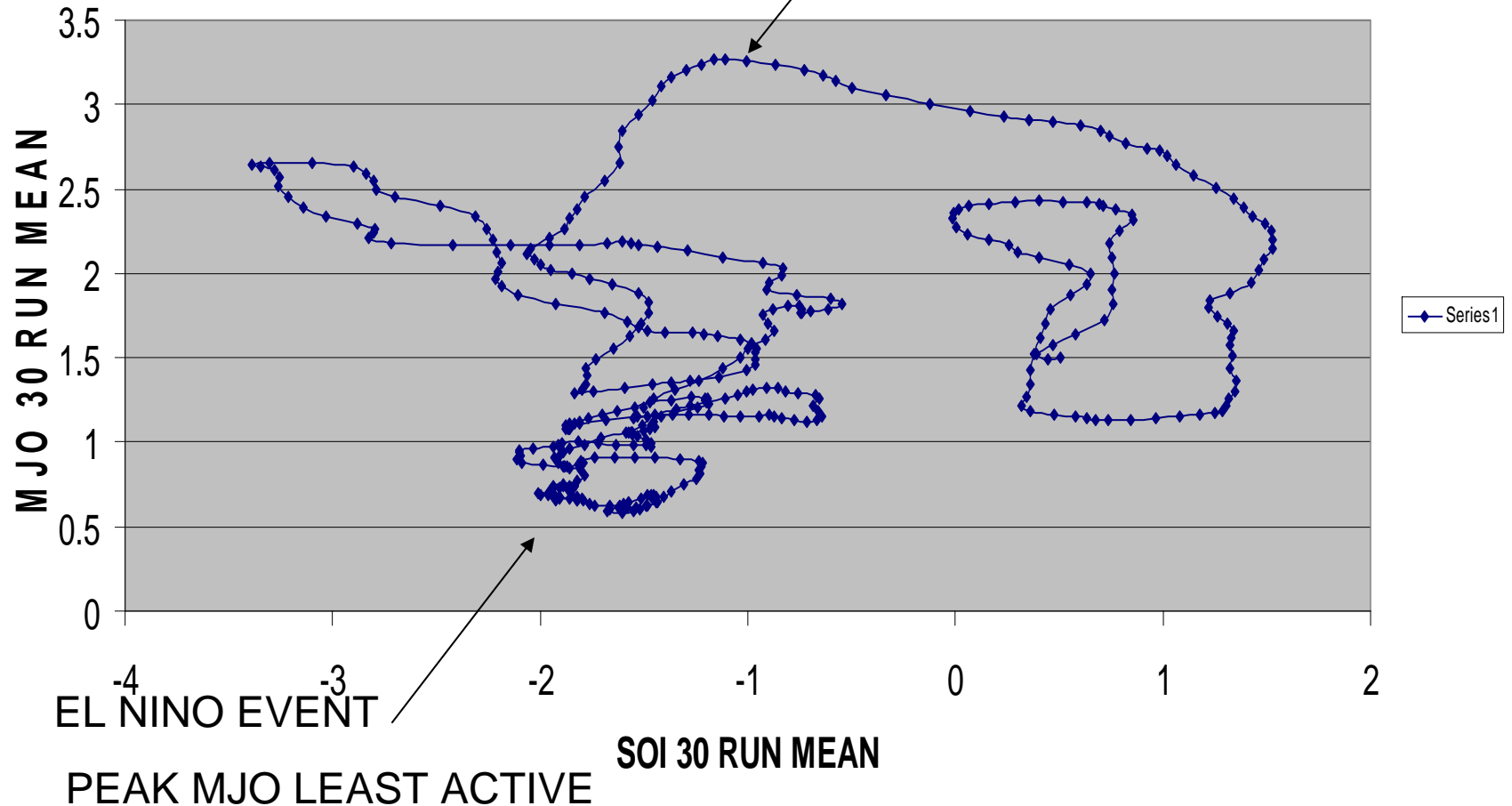


PC input=createdPCs.15sn.74toRealtime.txt

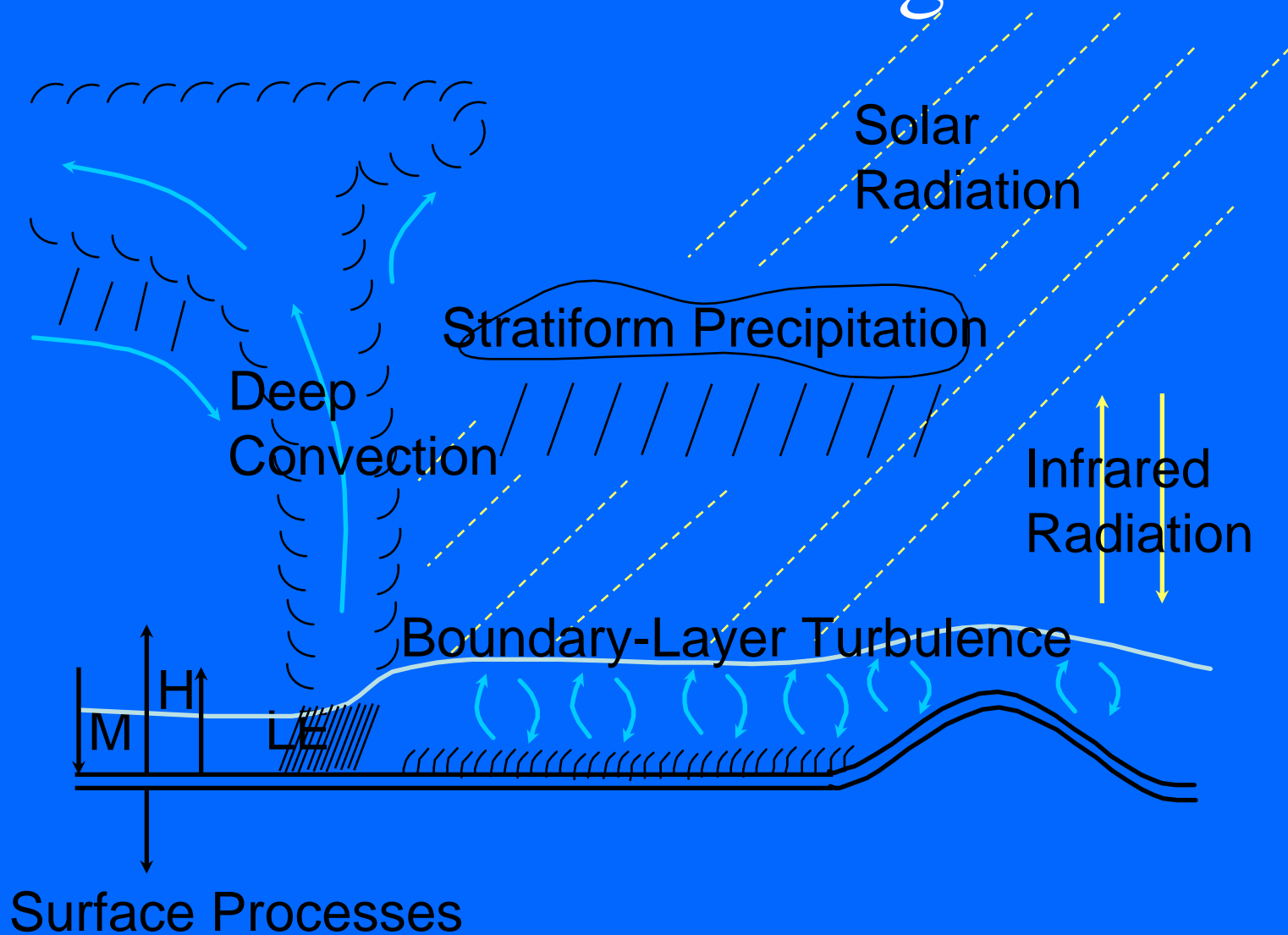
MJO VERSUS SOI DURING EXAMPLE DVLPG EL NINO -

MJO VS SOI FALL 1997-98 WINTER

MOST ACTIVE MJO AS SOI RAPIDLY CHANGES



Sub-grid Scale Physical Processes Critical for Modeling MJO



NAEFS ENSEMBLES

NOV 24 2007 15 DAY
OUTLOOK

What does this show?

*Cold and snow likely for
Vancouver –DEC 1-3*

RAPID WARMING DEC 3

and RAIN DEC 3-7

THESE ARE DAYS 7-15!

*If Occurs this would be a
series of Big Impacts!!*

HOW CAN A
FORECASTER QUICKLY
EXAMINE THE RELIABILITY
OF FORECASTS IN THE
EXTENDED REALTIME??

USE THE MJO WHEELER
DIAGRAM – MODIFIED BY
ENSO EVALUATION



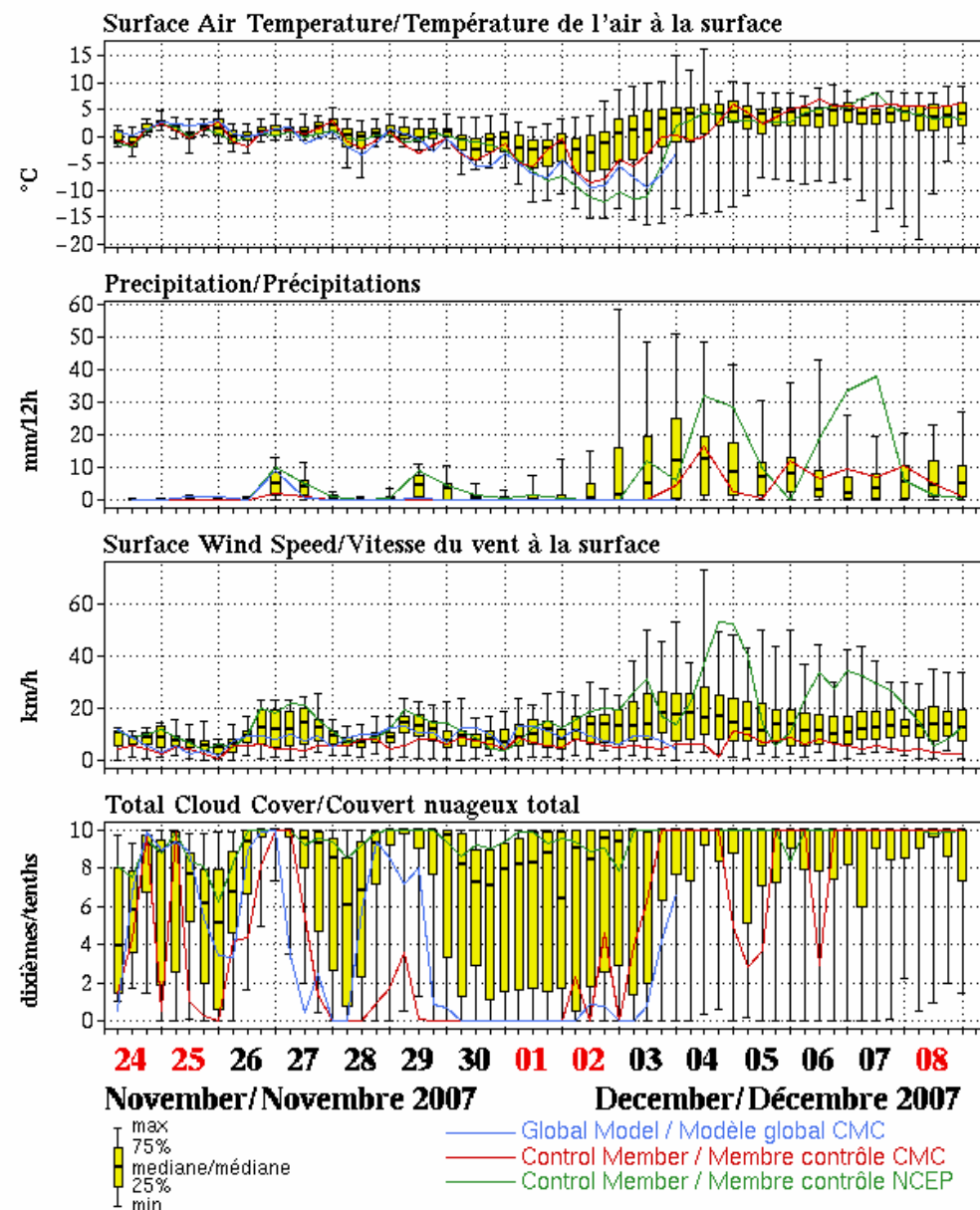
Environnement Canada
Centre météorologique canadien

Environment Canada
Canadian Meteorological Centre

Ensemble and Deterministic Forecasts issued 24 November 2007 00 UTC
Prévision d'ensemble et déterministe émises le 24 Novembre 2007 00 UTC
for/pour

NAEFS / SPENA

VANCOUVER INTL (YVR) 49.2 N 123.17 W/O



LONG RANGE FORECAST

CMC Global fcst

144 hr

Deep Trough along
west coast

Strong flow from Arctic

Northerly flow at sf c

moisture from
northwest.

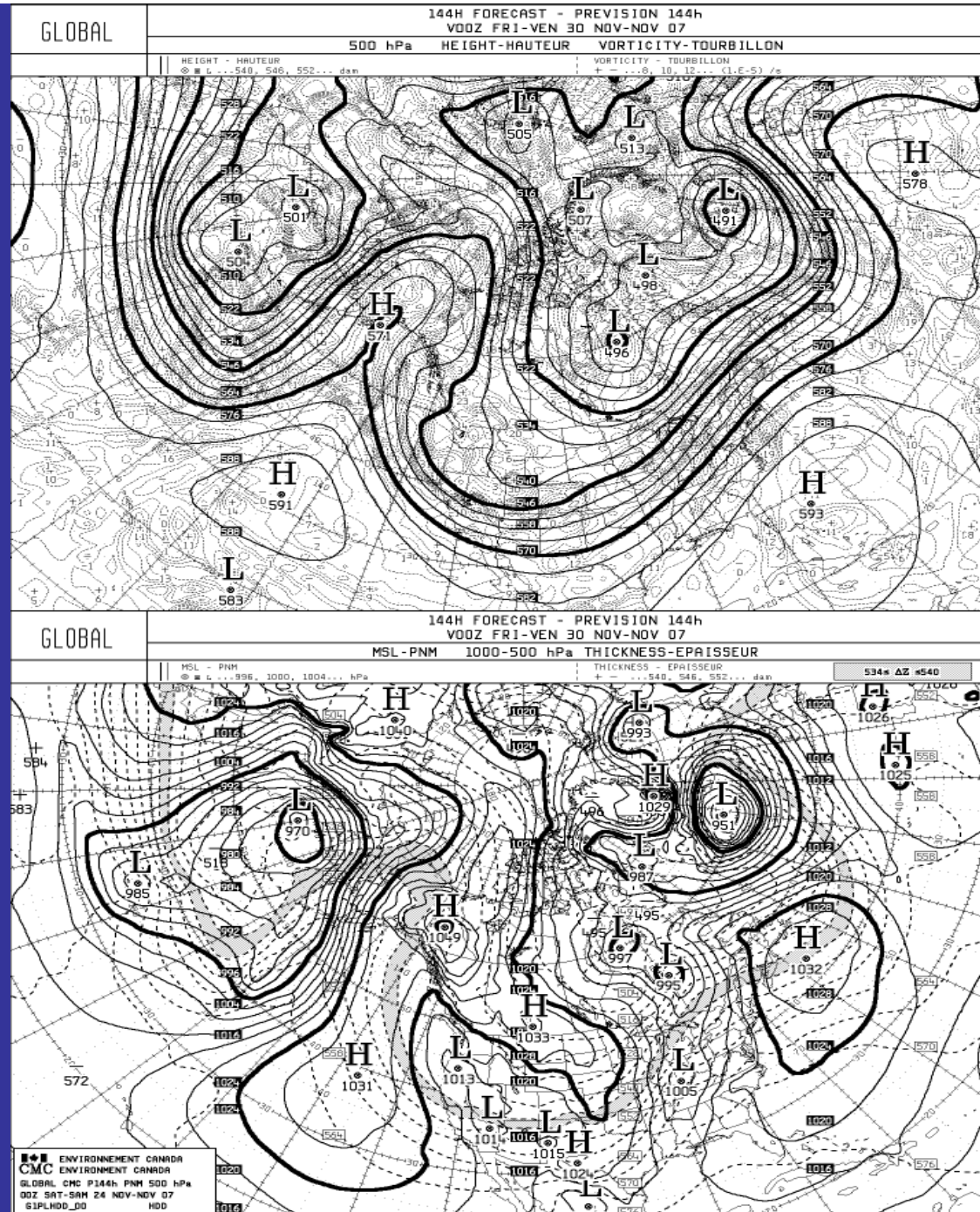
Carves over ocean –
and can bring more
instability near S coast.

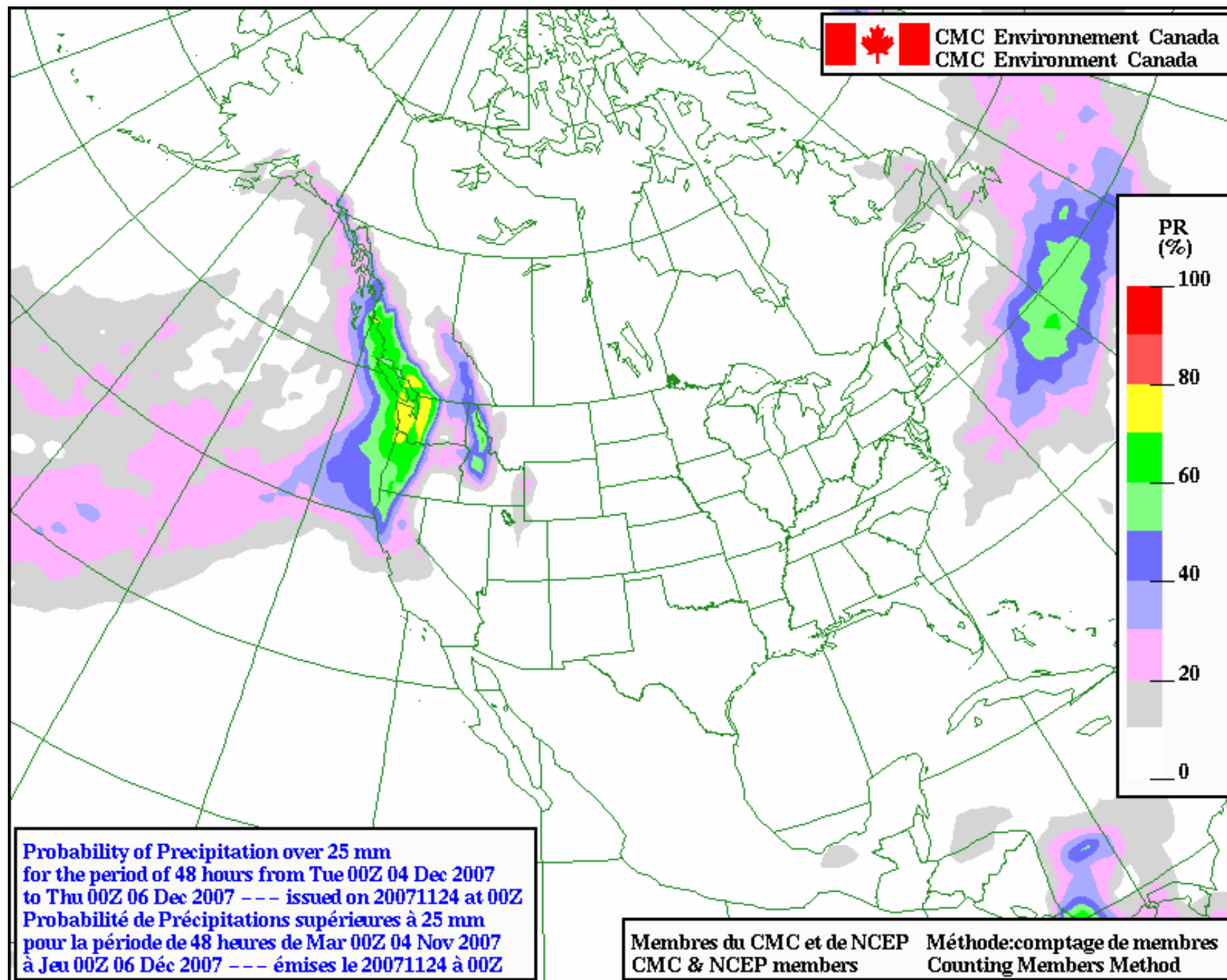
Inverted Sfc Trough

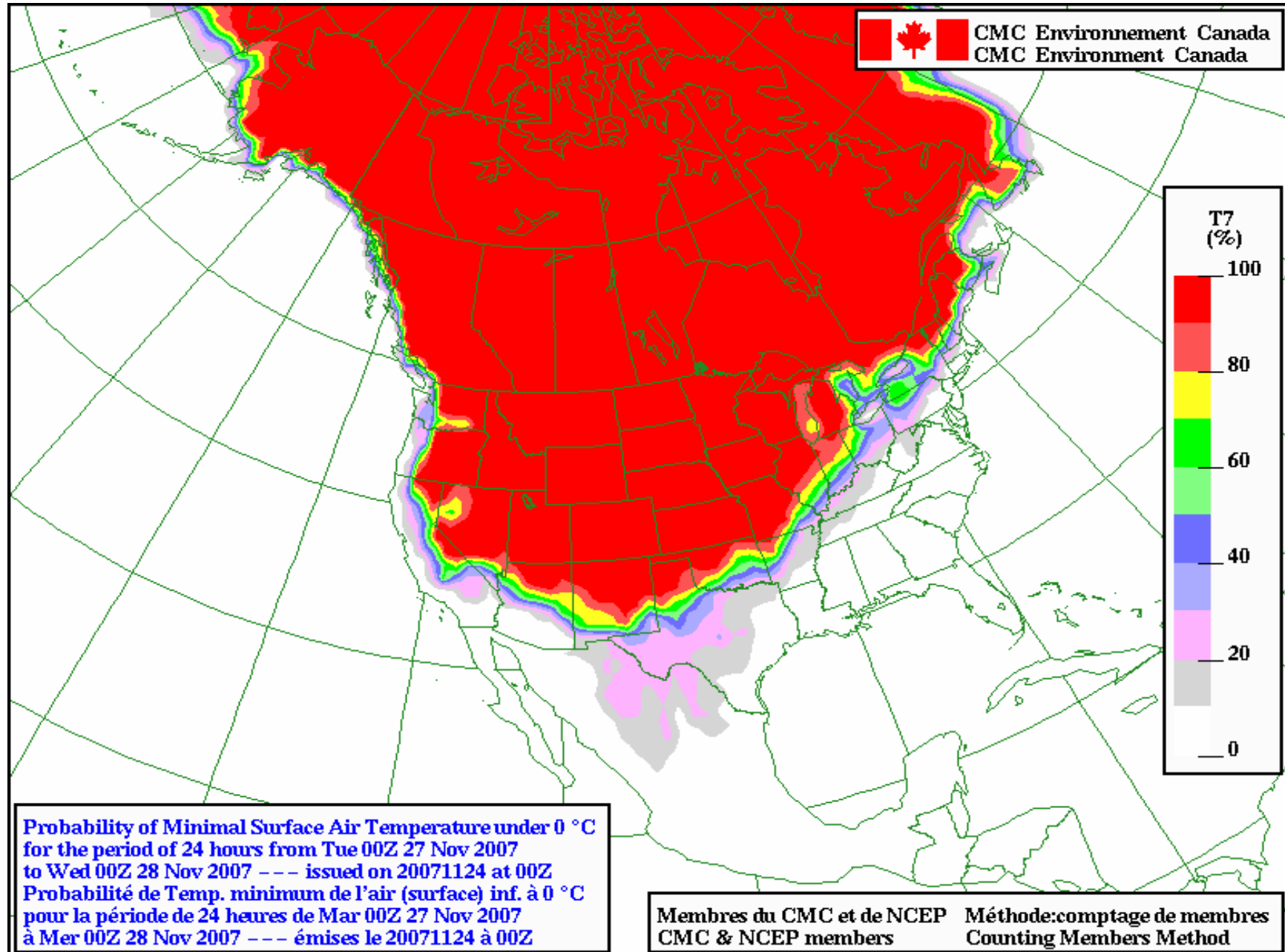
Spills a lot of water

Possible snow event

South Coast / Squamish

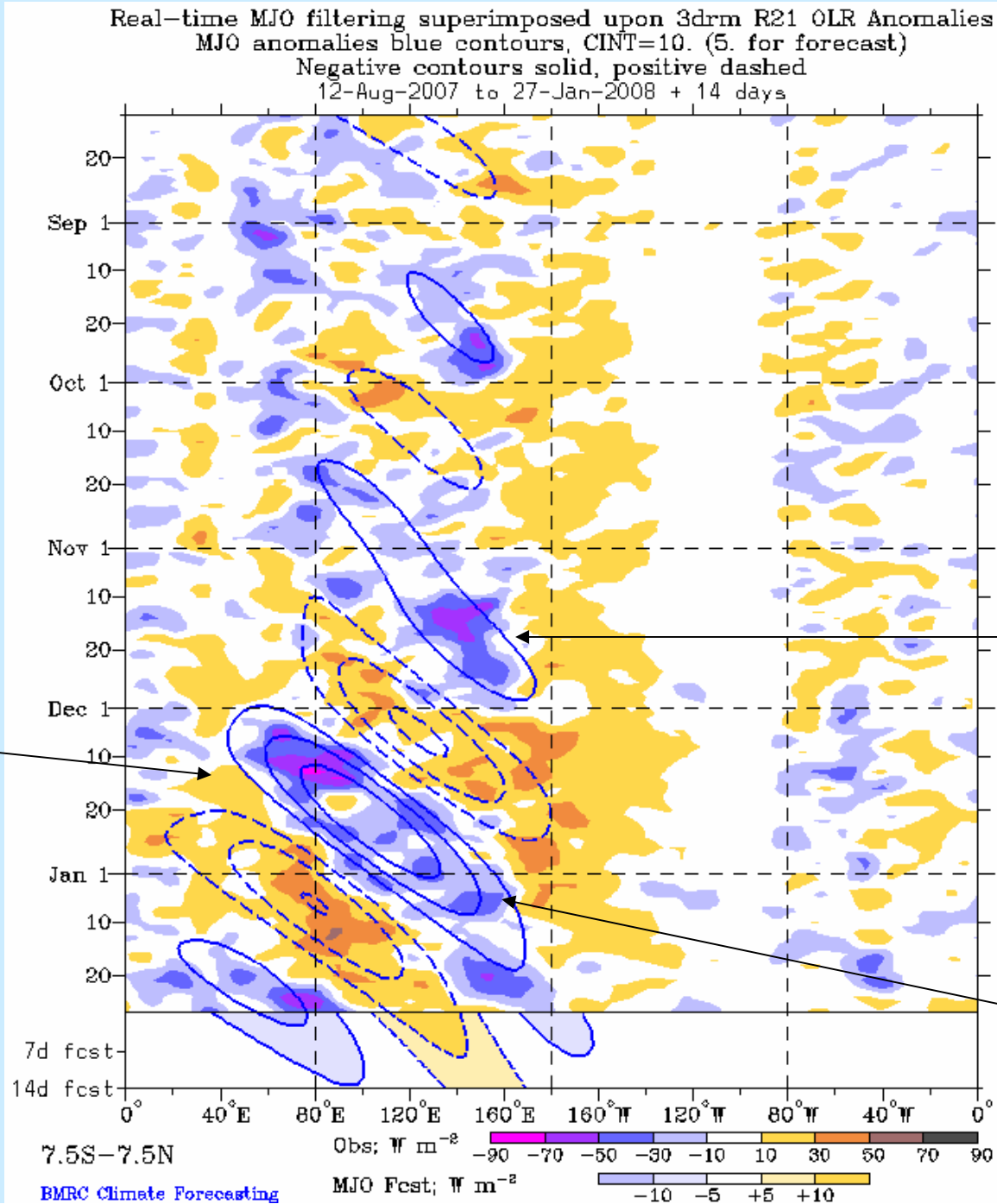






OUTGOING
LONGWAVE
RADIATION
ANOMALIES
EQUATORIAL

CLOUDY
COOLER
REGION
PROPAGATE
EASTWARD
CYCLE 20 TO
90 DAYS



FIRST FALL
MJO CYCLE
MID OCT TO
BEGIN DEC

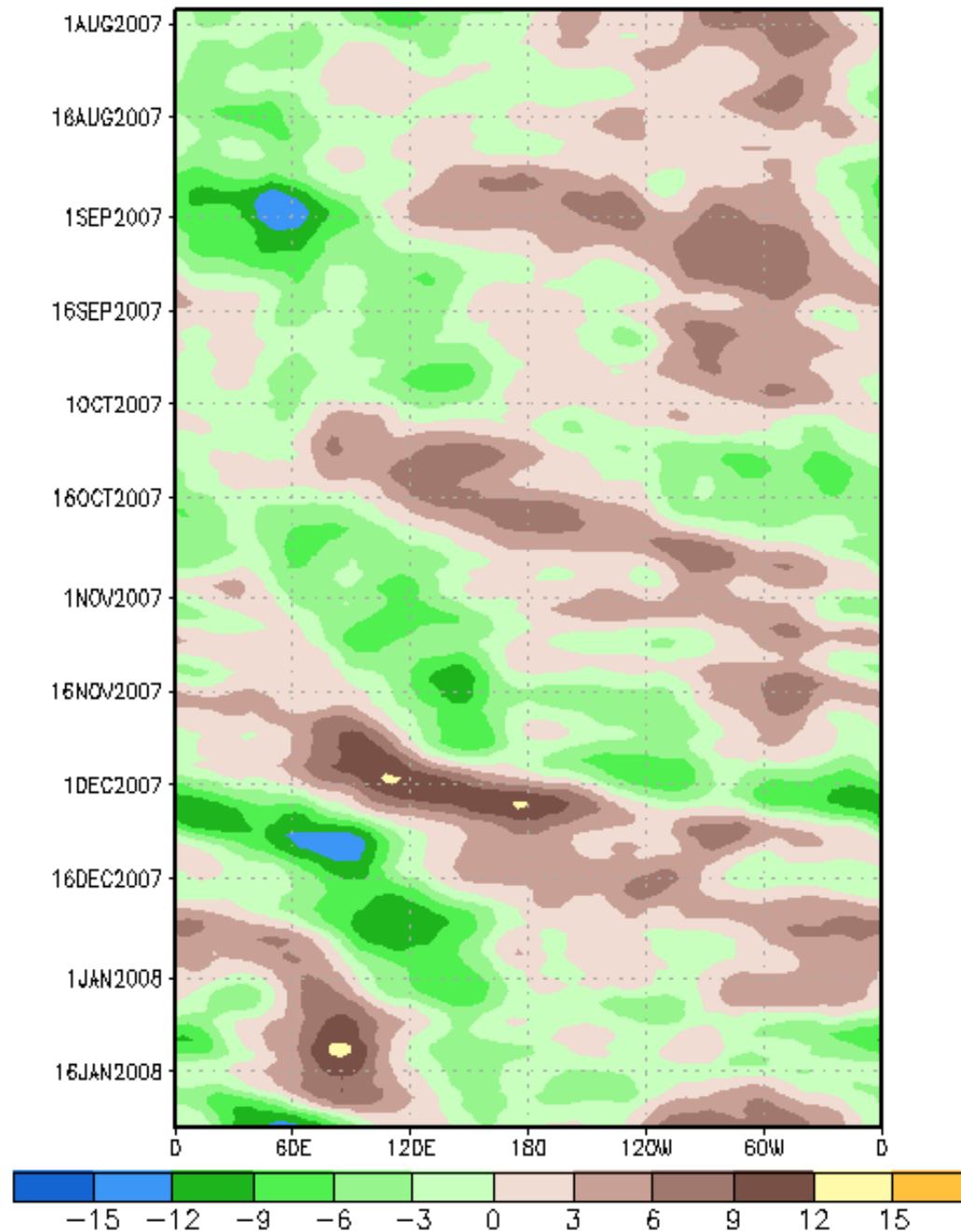
SECOND MJO
CYCL EARLY
DEC TO LATE
JAN

AUGUST
2007

JAN 28
2008

200-hPa Velocity Potential Anomaly: 5N-5S

5-day Running Mean

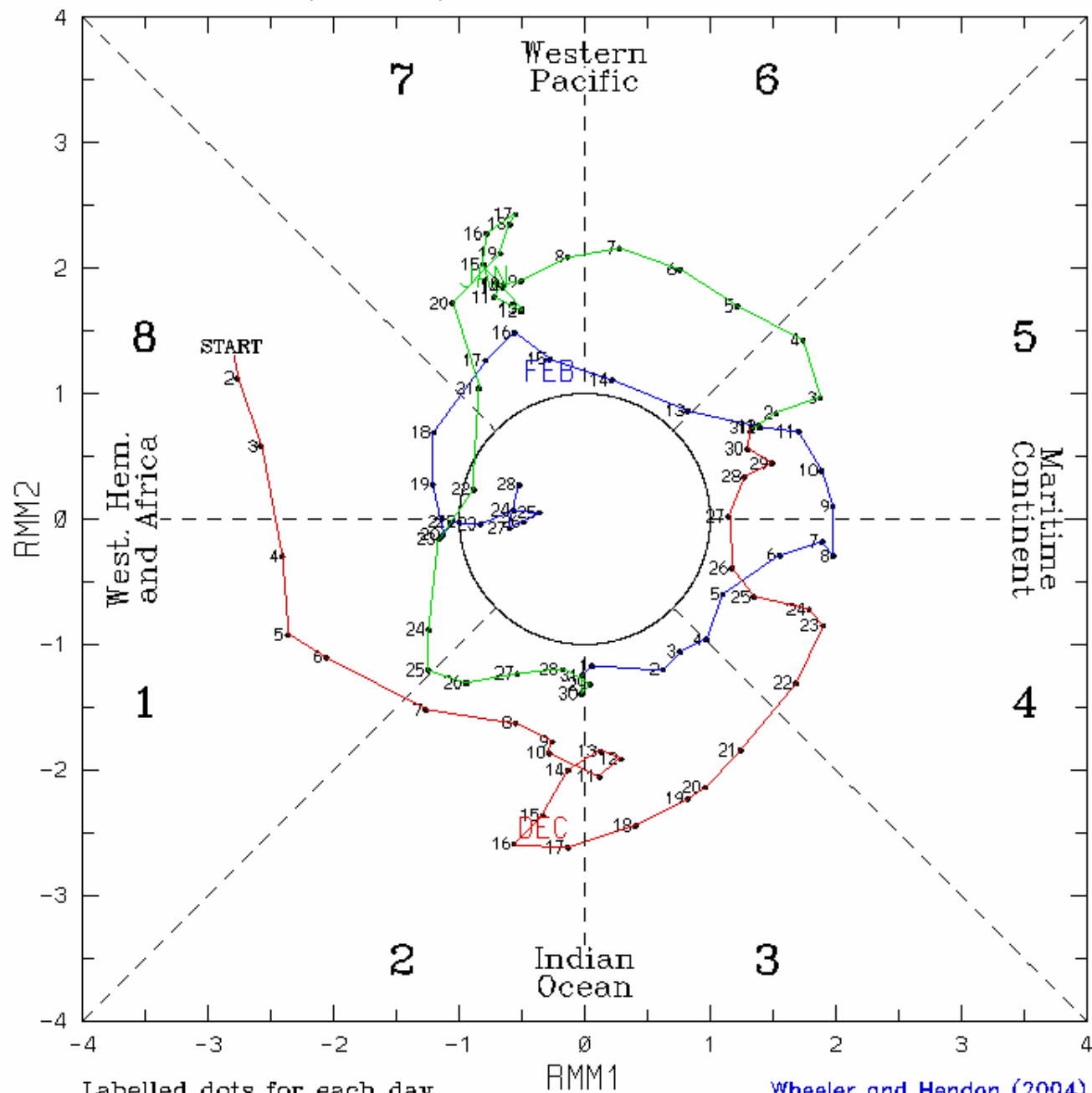


1. *What is the purpose of this research?*
 2. *What are the research objectives?*
 3. *What is the research methodology?*
 4. *What are the research findings?*
 5. *What are the conclusions?*
 6. *What are the limitations?*
 7. *What are the implications?*
 8. *What are the recommendations?*
 9. *What are the future research directions?*
 10. *What are the acknowledgments?*
 11. *What are the references?*
 12. *What are the appendices?*
 13. *What are the glossary?*
 14. *What are the abbreviations?*
 15. *What are the symbols?*
 16. *What are the units?*
 17. *What are the variables?*
 18. *What are the parameters?*
 19. *What are the constants?*
 20. *What are the functions?*
 21. *What are the operators?*
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 221.



Wheeler and Hendon (2004)
BMRC Climate Forecasting

(RMM1,RMM2) phase space for 1-Dec-2007 to 28-Feb-2008



Labelled dots for each day.

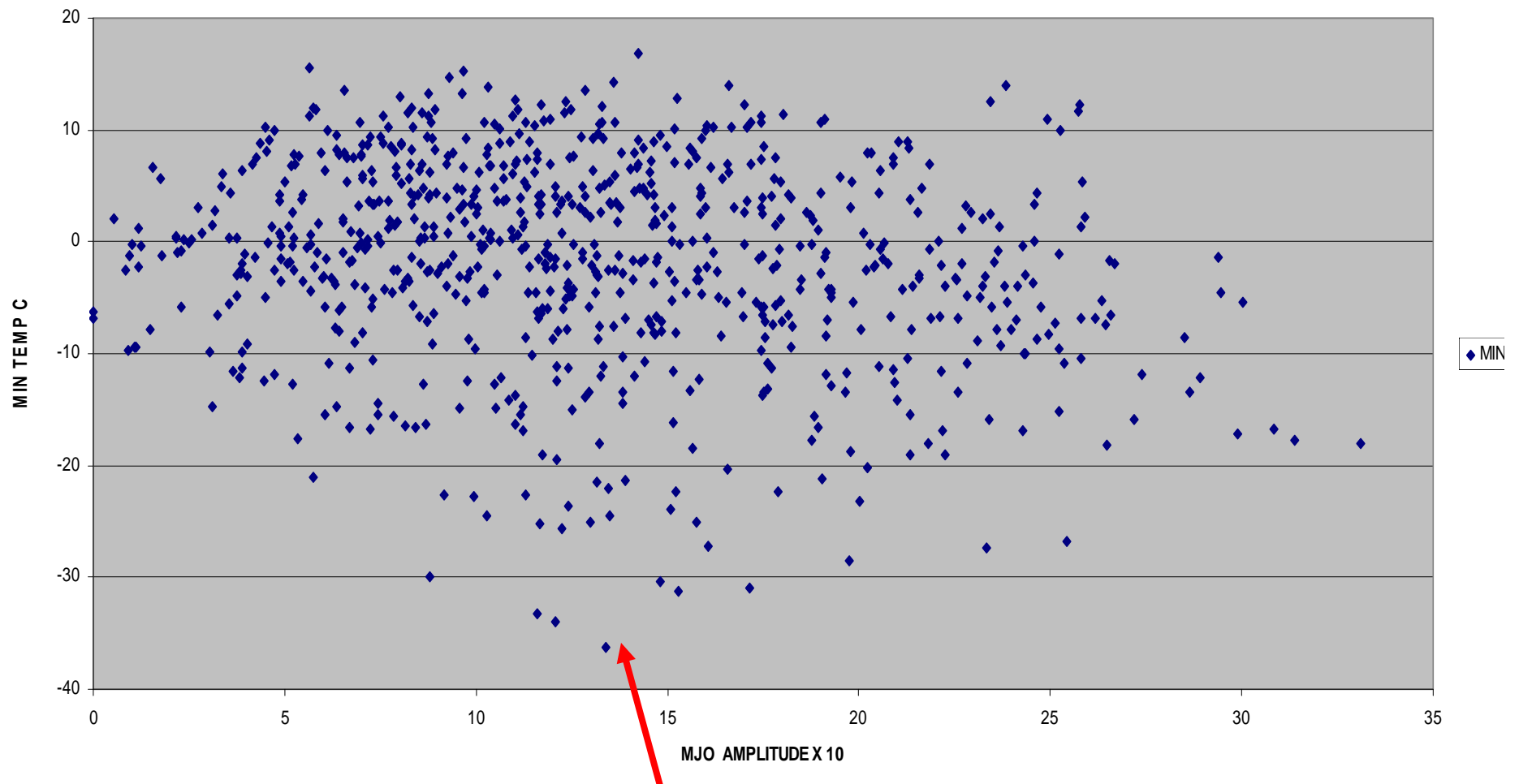
Blue line is for Feb, green line is for Jan.

Wheeler and Hendon (2004)

BMRC Climate Forecasting

MJO AMPLITUDE VERSUS MIN TEMP PRINCE GEORGE BC 2006-08

MIN TEMP YXS MJO



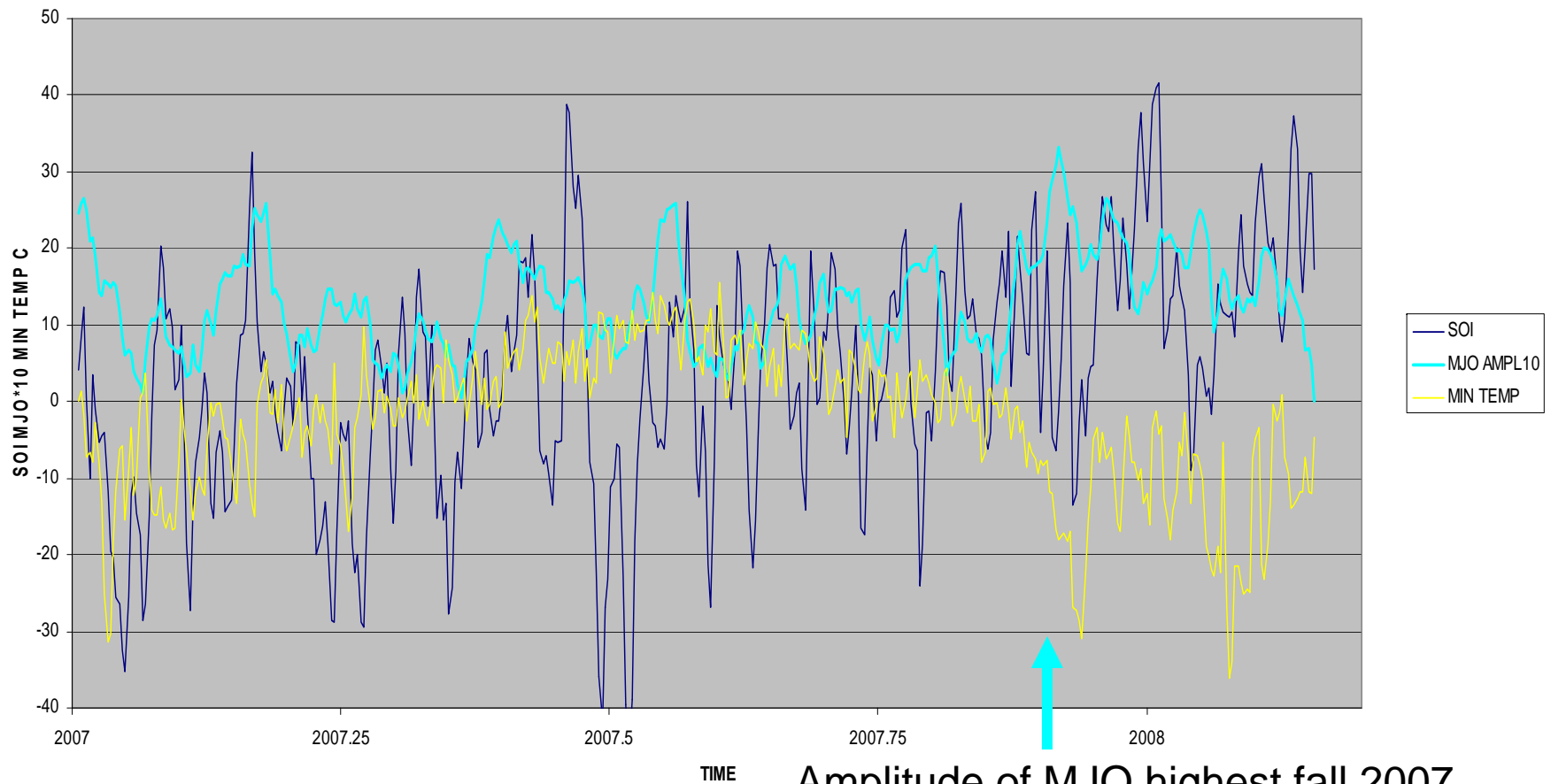
COLDEST MIN TEMPS DURING MODERATE AMPLITUDE MJO

MJO, SOI(ENSO) AND YXS TEMPERATURE 2007-8

2007 El Nina (-SOI)

PRINCE GEORGE SOI MJO MIN TEMP 07-08

2007-08 LA Nina (+SOI)

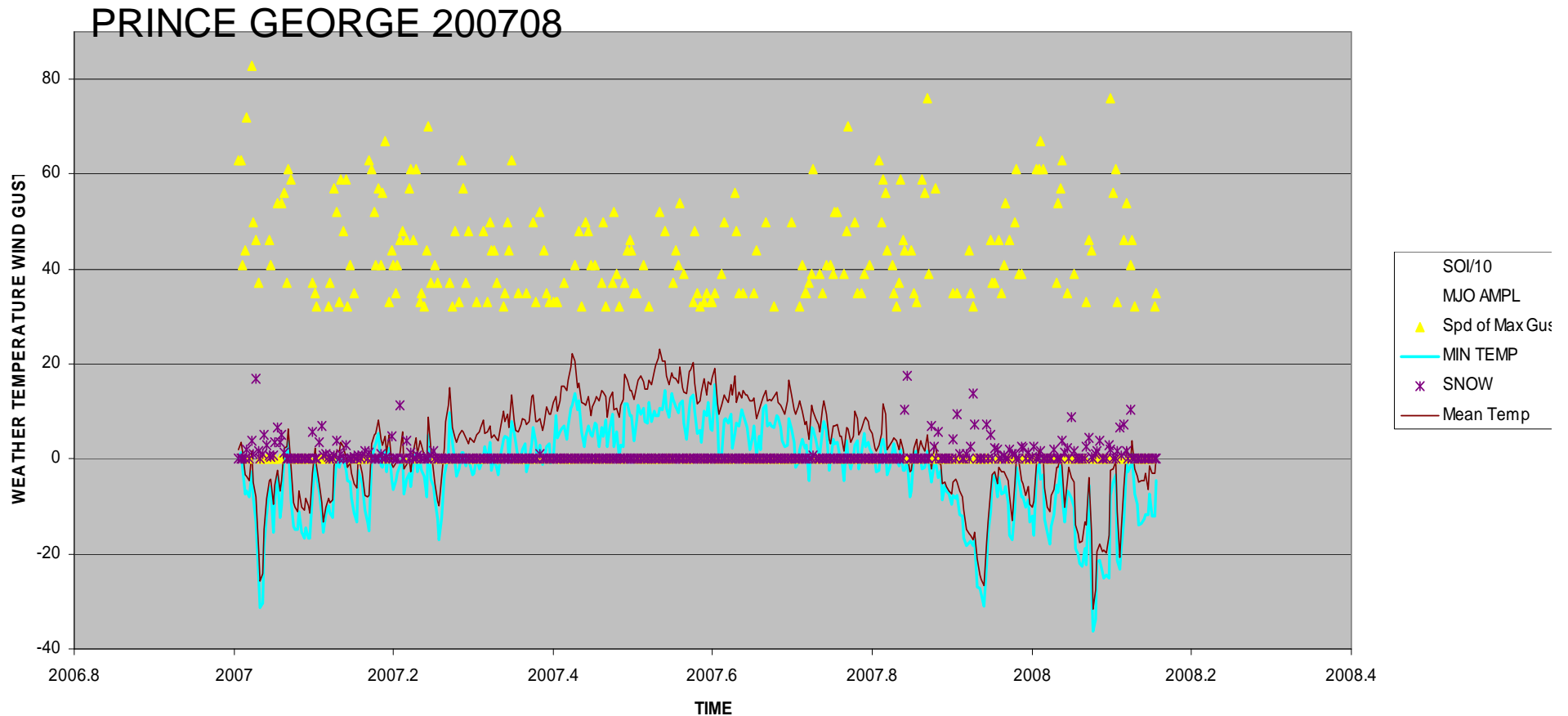


Amplitude of MJO highest fall 2007

as SOI rising and La Nina becoming strong

COLD EVENTS, WIND BURSTS AND STRONG MJO CYCLES IN 2007-8

PRINCE GEORGE 2006-7



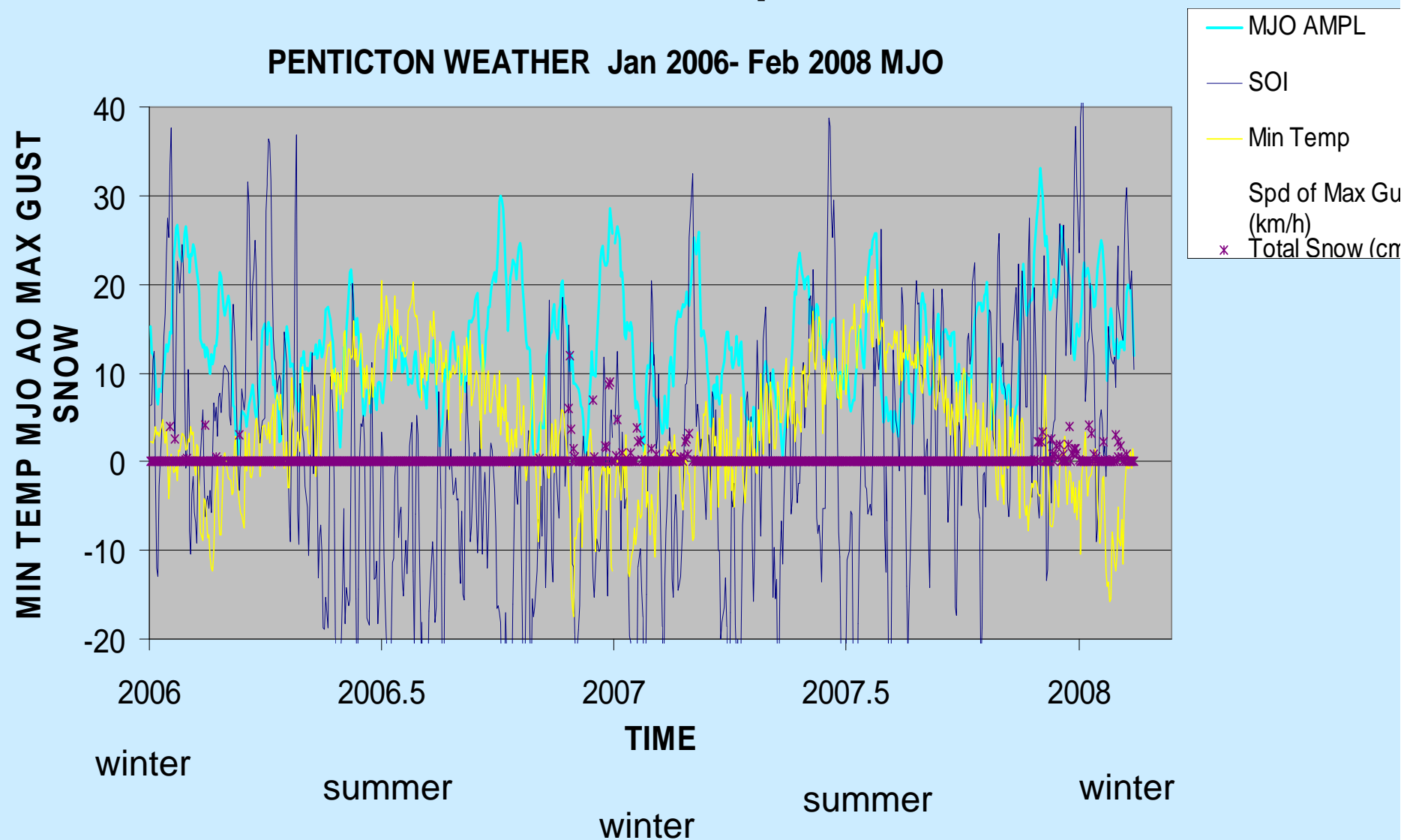
2007 WINTER

HEAVY SNOW COLD BC

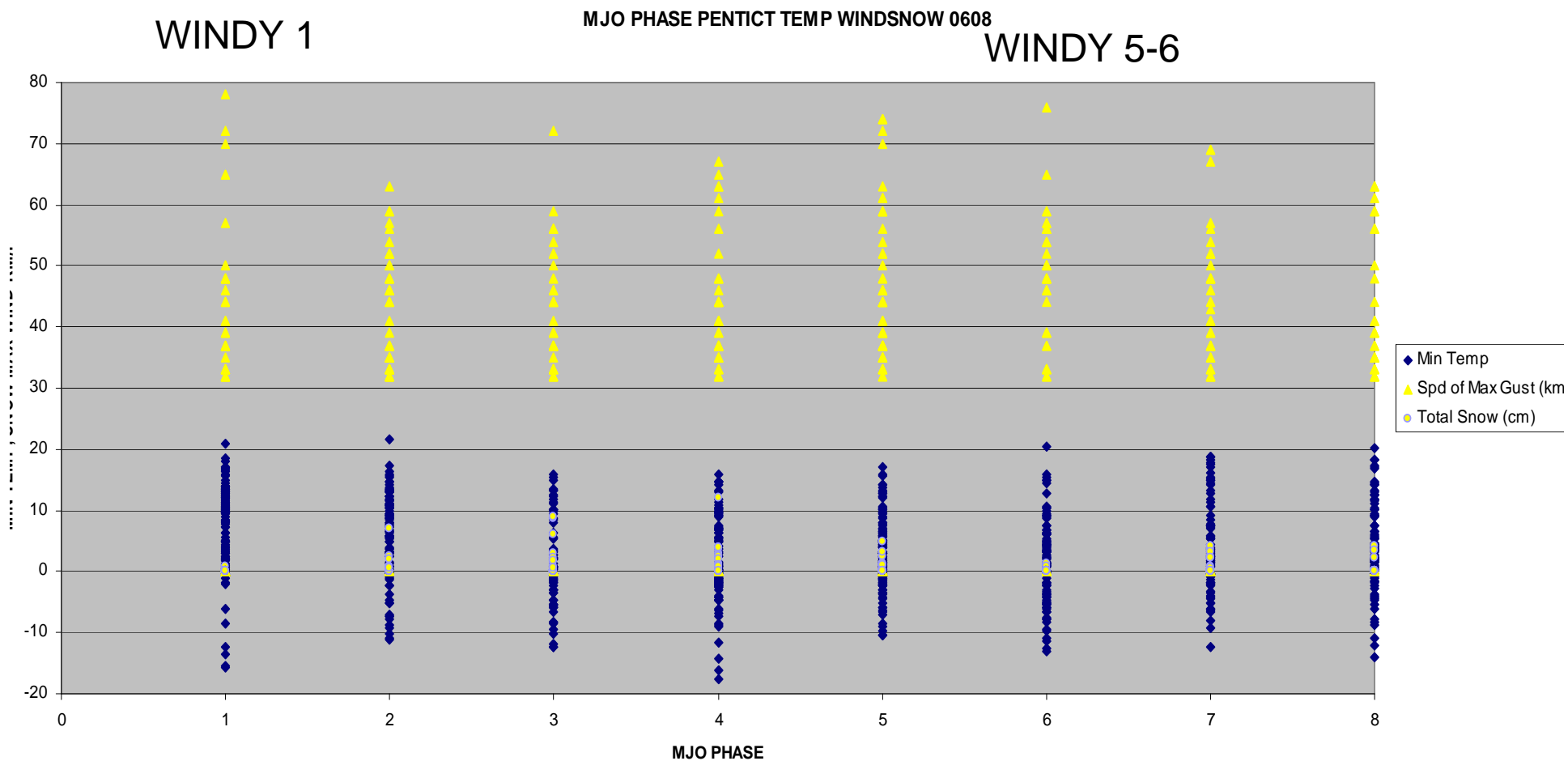
2008 WINTER

MAJOR FREEZEUPS IN BC INTERIOR

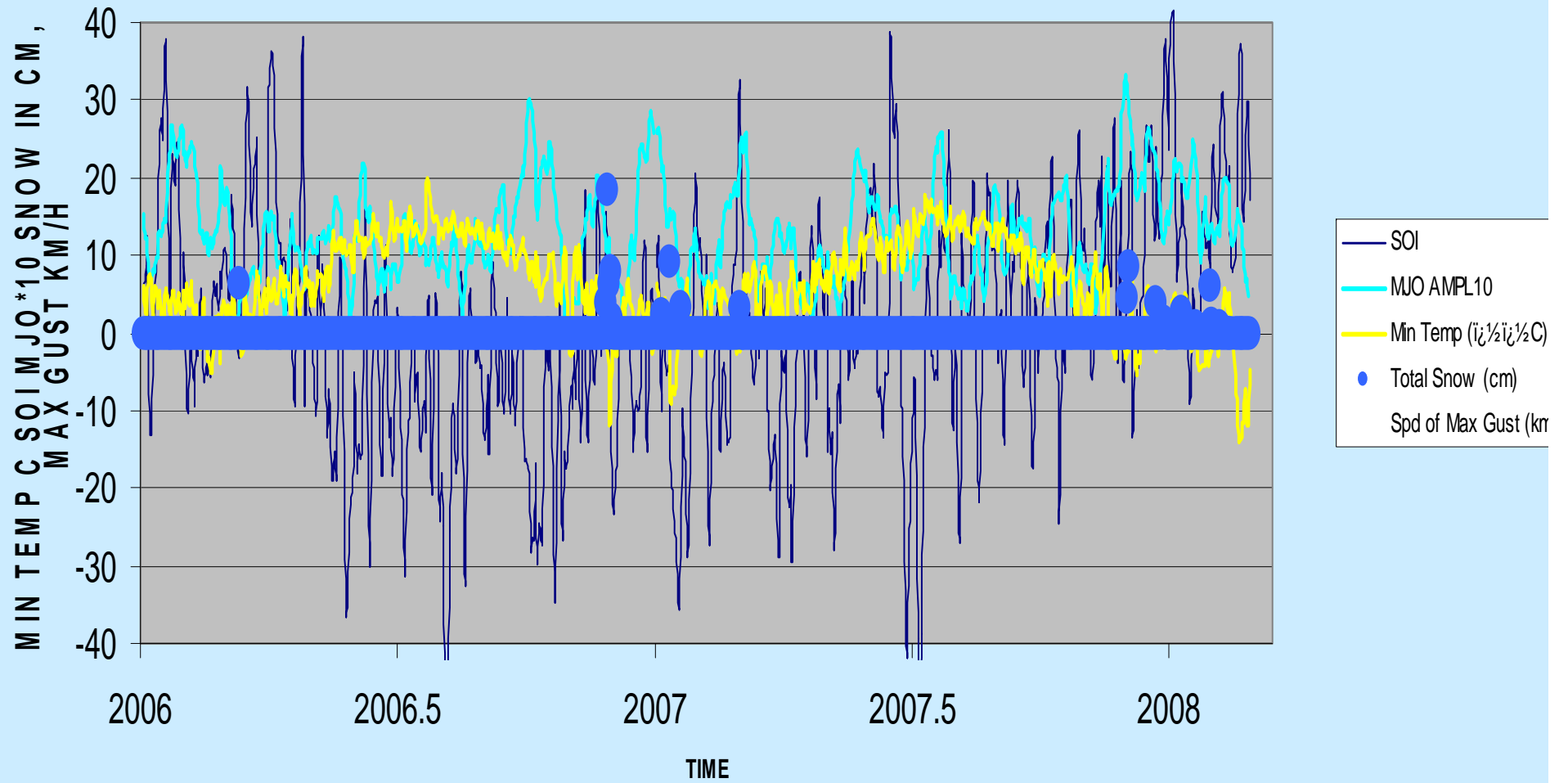
MJO and ENSO Relationship to Penticton Temperature



MJO PHASE AND PENTICTON WEATHER Nov 2006- Feb 2008



VANCOUVER BC MJO SOI WEATHER 2006-8



UTILITY OF MJO WHEELER DIAGRAM FOR EXTENDED FCSTS

- HOW CAN A FORECASTER QUICKLY EXAMINE THE RELIABILITY OF Extended forecasts REALTIME??
- **USE THE MJO WHEELER DIAGRAM –**
 - **MODIFIED BY ENSO EVALUATION**
- **TYPICAL PATTERNS MJO PHASE 1 – 8**
- Most active during start (an end?) of ENSO events
- Most active during La Niña (cold ENSO) events
- Most Inactive during El Niño (warm ENSO phase) – and activity briefly wanes during early February.
- Related convection often co-located with Typhoons
- Western Wind Events WWE and wind storms phase 2, 6
- Severe storms – and overriding snow events Phase 8 and 1
- Major blocking w/COLD Arctic air/REX builds phases 7,8 1
- Blocking dramatically ends as westerly flow dvlp phase 2-5

MJO AO TIME SERIES 1990 - 2000

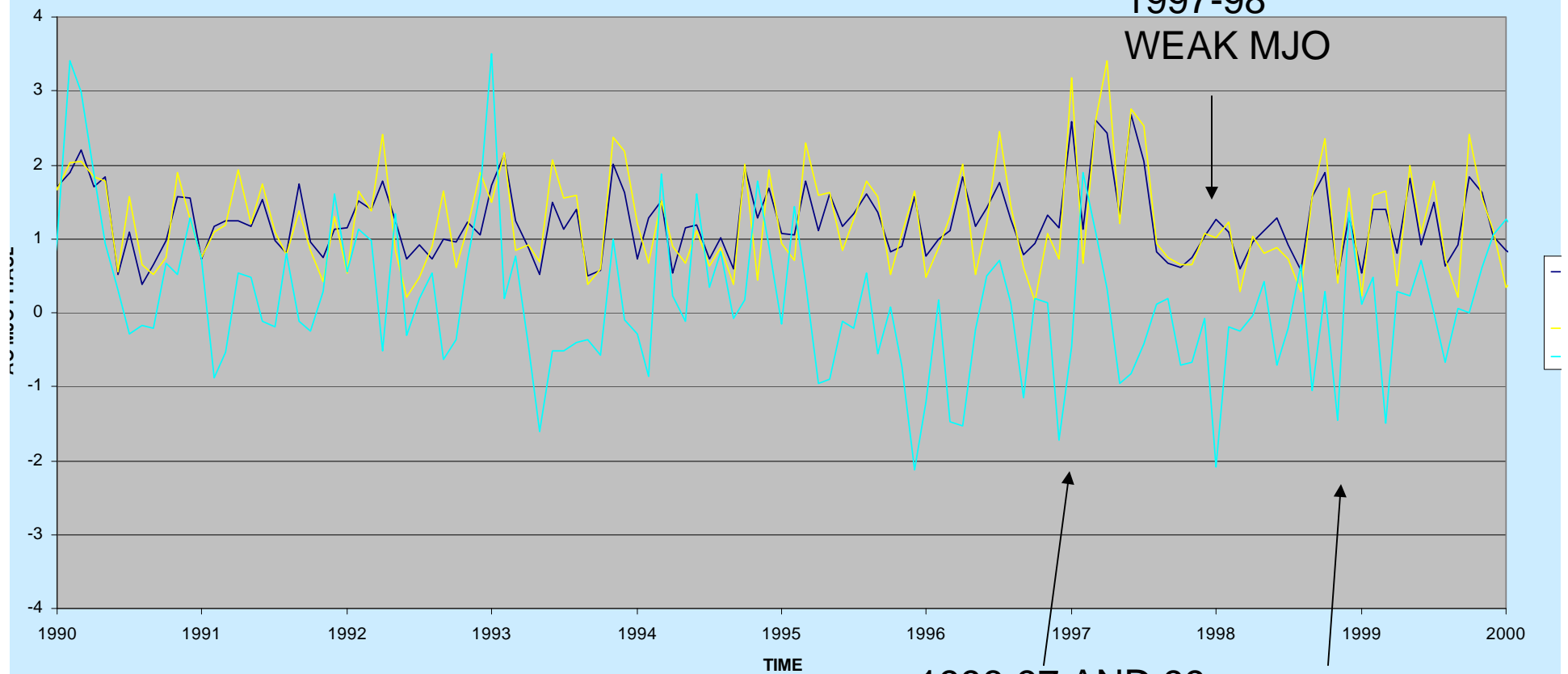
AO MJO TIME SERIES 74 TO 2008

GREATEST

EL NINO

1997-98

WEAK MJO



River Forecast Centre Ministry of Environment

Basin Snow Water Index

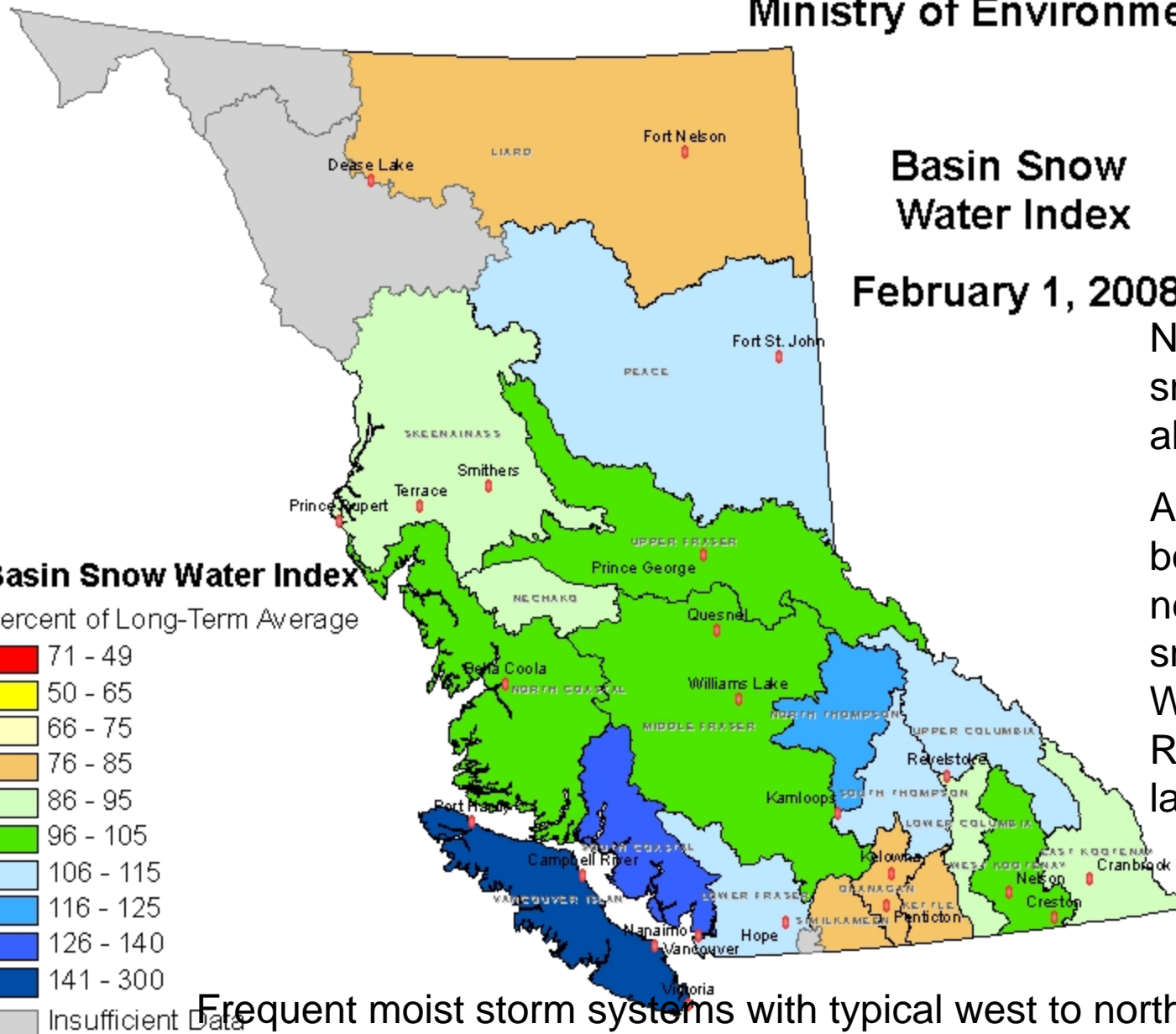
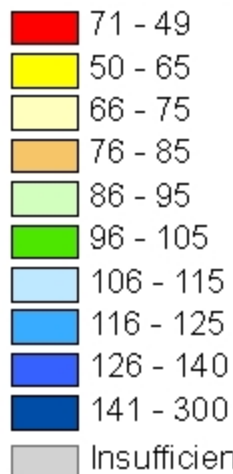
February 1, 2008

Near Normal Mountain
snowfalls except
above normal in sw

Above normal valley
bottom snowfalls -
near record vly
snowfall totals at
Whistler and
Revelstoke due to long
lasting cool Temp

Basin Snow Water Index

Percent of Long-Term Average



Frequent moist storm systems with typical west to northwest flow aloft
built mountain snow packs to normal to above during MJO Phase 2 to 5
Greatest valley snow and south cstl snws occurred in MJO phase 8-1 .

CONCLUSION

- MJO WHEELER DIAGRAM IS USEFUL FOR LONG RANGE TRACKING OF CYCLES
- ANALOGY METHOD BEST PRESENTLY
- ENSEMBLES ARE GETTING BETTER
- MJO OSCILLATION AFFECTS BLOCKING BUT ACTS WITH ENSO
- ENTIRE ATMOSPHERE REFLECTS INTERACTION FROM NORTH TO S POLE
- QUASI PERIODIC AND EPISODIC . BUT RELATED

MOUNT BAKER ...WILL
WE SEE IT BREAK YET
ANOTHER RECORD?





MSC/SMC-CMC GOES-10 2003-01-25 03:00 UTC 06.70

CELSIUS

-5

170

-12

-18

-25

-31

-37

-44

-50

-57

-63

-70

ROLE OF
BACK
BUILDING
VAPOR
PLUMES AND
CONVECTION
CRITICAL

W160

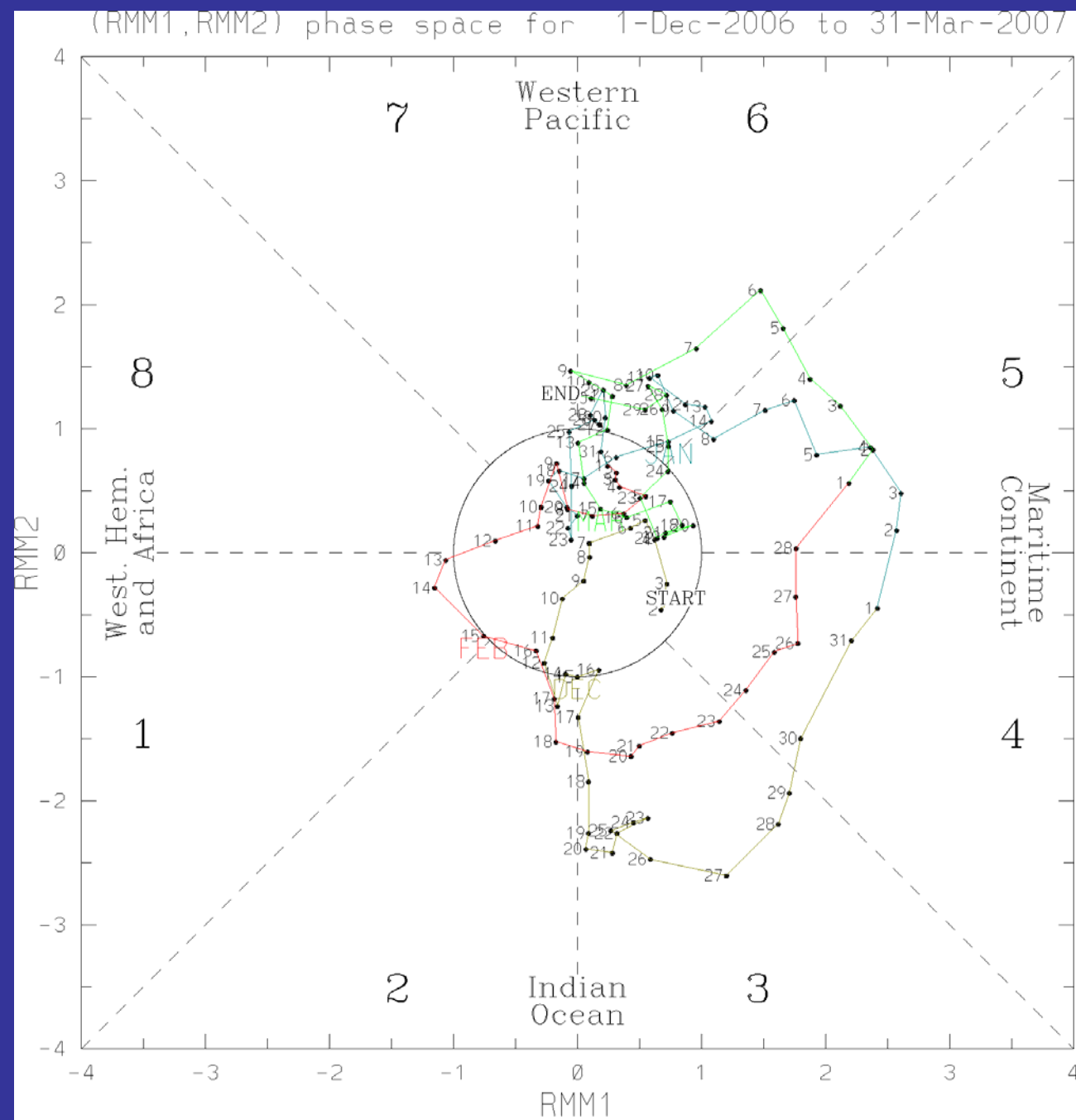
W150

W140

W130

W120

180



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